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James C. Lewis
U.S. Fish and Wildlife Service

Ernie Kuyt
Canadian Wildlife Service

Kenneth E. Schwindt
Aransas National Wildlife Refuge

Thomas V. Stehn
Aransas National Wildlife Refuge

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JAMES C. LEWIS, *U.S. Fish and Wildlife Service, P. O. Box 1306, Albuquerque, NM 87103*
ERNIE KUYT, *Canadian Wildlife Service, 4999-98 Avenue, Edmonton, Alberta T6B 2X3, Canada*
KENNETH E. SCHWINDT, *Aransas National Wildlife Refuge, Box 100, Austwell, TX 77950*
THOMAS V. STEHN, *Aransas National Wildlife Refuge, Box 100, Austwell, TX 77950*

Abstract: A total of 1,893 whooping cranes (*Grus americana*) overwintered at Aransas National Wildlife Refuge from 1950 through spring 1987. Winter losses (dead and disappeared) amounted to only 1.3% of the population, but 3.7% of the juveniles. About 19% of the annual losses occurred in the wintering area where birds spend 5 to 6 months of the year. Eighty-one percent of the losses occurred from April to November. Losses on the summering area appear to be low. The most significant losses seem to occur during migration and may comprise between 60 and 80% of the annual losses. Migration involves only 17-20% of the birds' year, but a period when losses are high because they are exposed to new hazards as they travel through unfamiliar environments.

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Several authors have reported on aspects of mortality in whooping cranes of the Aransas-Wood Buffalo population. Kuyt et al. (1981) and Hunt et al. (1987) described the causes of death of individual juveniles, and Kuyt (1981) noted that chick mortality usually occurs during the first 2 weeks of life. Banding of flightless whooping cranes began in 1977 and up to 1984, over 76% of these chicks (48 of 63) survived their first migration (Kuyt & Goossen 1987). Survival from banding to 1 year later was 64.2%.

In this note we report the losses of fledged birds (1950-1987), the reported causes of death, and seasonal patterns of loss. Data were derived from files of the U.S. Fish and Wildlife Service and from unpublished Canadian Wildlife Service records.

METHODS

The winter census at Aransas National Wildlife Refuge in coastal Texas began in 1938 (U.S. Fish and Wildlife Service 1986). However, aerial surveys were infrequent during World War II. Beginning in 1950, aerial censuses were conducted weekly (weather permitting) in fall when birds first arrived and in spring before they departed northward (in files at Aransas National Wildlife Refuge) (Table 1: Columns A-C). Mid-winter censuses were accomplished monthly. From winter 1955 through winter 1986 aerial censuses were scheduled weekly while whooping cranes were present.

Aerial censuses in the Canadian nesting grounds since 1967 have concentrated on a May inventory of nesting pairs and August surveys of families. Surveys have been conducted of hatching success and chick survival (June-August 1976-1988) and the pre-migration population (September 1981-1984). A total census has never been attempted in Wood Buffalo National Park because the area occupied by whooping cranes, and particularly by subadults, is too extensive for such counts.

We believe the fall censuses provide fairly complete counts of the arriving winter population, and spring censuses provide a good estimate of the population alive when spring migration began. Winter mortality estimates (Table 1: Column D) are based on the number of dead cranes found plus those birds that disappeared from the refuge dur-

ing the wintering period. The estimate of birds beginning spring migration (Table 1: Column E) is based on late March-early April aerial counts minus those birds which remained in Texas coastal habitats through summer (Table 1: Column F).

To calculate April through November losses of adults and subadults which had migrated (Table 1: Column G) in a particular year, the number of white-plumaged birds in Texas in early winter was subtracted from the pervious year's combined total of cranes migrating northward and cranes summering in Texas.

RESULTS

A total of 1,893 whooping cranes overwintered in the winter of 1950 to the spring of 1987; 98.2% (1,859) survived to migrate northward in spring. Ten stayed on the refuge in summer, 2 of which died while summering. The remains of 8 cranes were found in winter and 16 others disappeared and are presumed to have died in winter. Winter losses (24) amounted to only 1. 3% of the overwintering population. Deaths of the 8 recovered individuals are believed due to shooting (2 or 3), avian predator (1), disease and predation (1), and unknown (3). The last known shooting loss occurred in 1967-68 when a snow goose hunter shot a crane. Losses included 3 adults, 1 subadult, 3 juveniles and 1 whose age was not reported. The 4 white-plumaged birds were females. The 16 birds which disappeared included 6 juveniles, 3 subadults, 2 adults and 5 of unknown age. The total loss of 9 juveniles is 3.7% of the 240 juveniles which overwintered on the refuge between fall 1950 and spring 1987.

One hundred and thirty-three adults and subadults disappeared or were found dead from April to November 1950-1987 including the 2 birds which died while summering at Aransas. Carcasses of 11 (8.4%) of the 131 subadults and adults which had migrated were recovered. Two juveniles also were found dead during migration. Five of the 13 losses were due to collision with power lines, 4 others suffered trauma injuries due to collisions or gunshot injuries, 1 was shot, 1 died in a muskrat trap, 1 may have had a heart muscle disease and 1 may have had a viral infection.

Fifteen percent of the 157 total losses (1950-1987) occurred during the 5-6 months the whooping cranes annually spend on the wintering grounds. Remains of birds were more frequently found on the wintering area (33% of the carcasses recovered) than during the remainder of the year (8.4%).

The most complete census records have been maintained since summer 1977 when the Canadian Wildlife Service and U.S. Fish and Wildlife Service began placing colored leg markers on juveniles before they fledged. Over that time, 814 crane overwinterings occurred and 9 birds (1.2% of the population) died. Thirty-nine adult and subadult whooping cranes died 1977-1987 in April to November (81.2% of the total losses of those years).

Aerial surveys in summer at Wood Buffalo National Park indicate that summer (May-September) losses of adults and subadults are infrequent in the park; only 1 carcass has been found there since 1967.

DISCUSSION

For an average whooping crane, fall migration takes about 6 weeks including the staging period in Saskatchewan. Spring migration involves about 3 weeks for an average bird, although older experienced pairs make the trip in 2 weeks and subadults may take 4 weeks or longer to complete migration.

Between 60 and 80% of the annual losses of fledged birds may occur during migration, a period only comprising about 9 weeks (17%) of the bird's year. Spring and fall migrations are the periods we should concentrate on to further diminish mortality of fledged birds. Such actions are occurring through the Federal-State and Federal-Provincial cooperative plans for protection of whooping cranes (see Lewis in this proceedings) and through efforts to diminish collisions with power lines.

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Table 1. Losses among fledged whooping cranes of the Aransas-Wood Buffalo population, 1950-1987.

Winter beginning	White-plumaged	Total	Winter losses	Migrating in spring	Summering in Texas	Calculated Apr-Nov losses
A	B	C	D	E	F	G
1950	26	31	1	29	1[a]	9
1951	20	25	2	23		4
1952	19	21		21		0
1953	21	24		24		3
1954	21	21		21		1
1955	20	28	1	26	1	5
1956	22	24		21	3[b]	1
1957	22	26		26		3
1958	23	32		32		1
1959	31	33		31	2	3
1960	30	36		36		2
1961	34	39	1	38		6
1962	32	32	4	28		2
1963	26	33	1	32		0
1964	32	42		42		6
1965	36	44		44		6
1966	38	43		43		4
1967	39	48	1	47		3
1968	44	50		50		2
1969	48	56		56		5
1970	51	57	1	56		2
1971	54	59	1	58		12
1972	46	51	1	50		3
1973	47	49	1	47	1	1
1974	47	49		49		0
1975	49	57		57		0
1976	57	69		69		8
1977	61	71	1	70		2
1978	68	75	1	74		4
1979	70	76		76		4
1980	72	78	1	76	1	6
1981	71	73		73		6
1982	67	73	2	70	1	3
1983	68	75		75		4
1984	71	86	2	84		3
1985	81	97	1	96		7
1986	89	110	1	109		0[c]
Totals	1, 653	1, 893	24	1, 859	10	131

[a] The summering bird died in August of unknown causes.
[b] One summering bird died July 1, probably of shock after it was captured by refuge personnel.
[c] One hundred and nine white-plumaged birds returned to Aransas NWR in fall 1987.